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A National Environmental/Energy Workforce Assessment. Post-Secondary Education Profile: Abstract

National Field Research Center, Inc, Iowa City, IA

Prepared for

Environmental Protection Agency, Washington, DC

Dec 78

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Post Secondary Education Profile

ABSTRACT

Phase II
Of A National Environmental/Energy Workforce Assessment

Conducted by:

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16. ABSTRACT This study is one of 16 volumes aggregating data on representative environmental education offerings in the United States at post-secondary education institutions and in the private sector of the economy. Structured around on-site interviews, the study describes the institutions' education programs — their program structure, representative course offerings, faculty structure, and program requirements. In addition, the study provides information on the employment history of graduates.

Designed as Phase II of a three-phase program, the study presents the information on schools in the following volumes: two volumes on potable water and two on wastewater; one volume each on air, noise, pesticides, radiation, solid waste and energy; a two-volume composite report on environmental engineering/health; a one-volume report on education/ecology; and a volume on some training programs conducted by businesses and by trade and professional associations. In addition, the study includes a one-volume abstract and a one-volume summary. The study is an overview. It doesn't include all environmental programs in the United States, and it makes no attempt to evaluate the program offerings.

Phase I of the study assessed the workforce needs (manpower needs) for pollution control and abatement in the United States for the five-year period of 1976 through 1981. Phase III, which will be available in September 1979, will offer recommendations, curriculum changes, and modifications that appear necessary to assure a properly trained national environmental workforce

17. KEY WORDS AND DOCUMENT ANALYSIS

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Solid Wastes	Environmental Education		
Potable Water	Environmental Protection		
Pesticides	Pollution Control		
Radiation	Instruction		
Noise Pollution	Schools		
Energy	Education		
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PHASE II

POST-SECONDARY EDUCATION PROFILE

ABSTRACT

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Under Grant from:

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ENVIRONMENTAL PROTECTION AGENCY

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1978

This document has been reviewed by the Environmental Protection Agency and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

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INTRODUCTORY NOTE

The National Environmental/Energy Workforce Assessment: Post-Secondary Education Profile was conducted by National Field Research Center, Inc. with main offices in Iowa City, Iowa. The following personnel have had primary responsibility for the development of the project report.

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Appreciation is extended to the many individuals, institutions, and organizations who generously contributed to the success of this national project. Of particular import are those contact persons listed in the program summaries. Their time and assistance in preparation, input and review represents the foundation upon which the National Environmental/Energy Workforce Assessment - Phase II rests.

Sincere appreciation is expressed to those persons within the United States Environmental Protection Agency, Office of Federal Activities, who provided guidance and direction throughout the term of the project: Mr. J. Donald Cook, Project Officer; Mr. Joseph McCabe, and Mr. Michael Moore.

Gratitude must be expressed to the many individuals and organizations from the private sector who were most generous in their contribution to this project. Their openness and responsiveness reflect their concern regarding the training of our environmental workforce and their critical role in that effort.

FOREWORD

Information for this report was largely compiled from on-site interviews with professionals in post-secondary institutions throughout the United States. On-site interviews were supplemented by telephone and/or mail contact to clarify and revalidate the data. This report presents a summary of programs in junior colleges, and vocational/technical training institutions. Programs are representative of all levels from academic certification through doctoral degrees. The environmental pollution control areas of air, noise, pesticides, potable water, radiation, solid waste, wastewater and energy were surveyed.

This study was conducted for the United States Environmental Protection Agency by the National Field Research Center, Inc. of Iowa City, Iowa, with field offices located in Atlanta, Georgia; Denver, Colorado; and Washington, D.C.

INTRODUCTION

Phase II of the National Environmental/Energy Workforce Assessment was structured around an intensive on-site inventory of representative environmental educational offerings on a national scale. The primary objective of this project has been to collect and aggregate data on training and educational programs in both the post-secondary education field and in the private sector, and to do so by environmental area. Specifically, the study was designed to provide an overview of environmentally related post-secondary education programs, their program structure, representative course offerings, employment history of the graduates, and the faculty structure. Additionally, information was to be collected on program requirements and program projections.

Initially, opportunities to nominate programs for inclusion in this on-site review process were given to the Environmental Protection Agency and its program officers,and regional personnel both through the Project Officer and via direct mail requests; all state departments of education; state environmental agencies;and selected media-specific associations. These nominations were supplemented by a direct review of institutional catalogs, information obtained during the first year's on-site activities, and a review of other published sources of information regarding degree programs in environmental areas.

Following their initial development, the lists of nominees were forwarded to the program officers for suggestions regarding additions or deletions. Letters were then written to those nominated institutions seeking their support and cooperation in the on-site review process.

In preparation for the on-site interviews, appropriate persons were contacted in the institution involved and were given a background description of the study, a suggested timetable for the interview process, and were told what kind of information was being sought. This was all done in an effort to keep the time involvement of the individual contact persons at a minimum. During the actual on-site interview, generally lasting around one hour, the information was collected, questions asked and answered, and further informational contacts identified. Following this process, each on-site interview was written up in the form of a Training Program Summary, which where time allowed, was returned to the contact person for critiquing prior to inclusion in the report.

The material presented in this booklet represents an extreme condensation of materials developed under the Post-Secondary Education Profile phase of the National Environmental/Energy Workforce Assessment. It has been developed in an attempt to provide the reader with a brief overview of the results of the entire study. In the cases of Potable Water, Wastewater and Composite Programs, one combined abstract has been developed even though handling and production constraints necessitated the development of multiple volumes in these areas to adequately report the findings.

The condensation of up to 600 pages of material in the space of two pages obviously results in the ommission of much pertinent material and requires many difficult choices. Readers desiring a more complete overview are urged to refer to the National Summary, which provides a six to ten page summary on each of the volumes. Those persons wishing an in-depth treatment of a particular subject should refer to the volume in question.

The entire final report consists of the following volumes:

AIR

COMPOSITE:
- I - Environmental Engineering/Health Programs
- I (CON'T) - Environmental Engineering/Health Programs
- II - Environmental Education/Ecology Programs

ENERGY

NOISE

PESTICIDES

POTABLE WATER:
- I - Single Degree Programs
- II - Multiple Degree Programs

RADIATION

SOLID WASTE

WASTEWATER:
- I - Single Degree Programs
- II - Multiple Degree Programs

BUSINESS AND INDUSTRY

NATIONAL SUMMARY

NATIONAL ABSTRACT

Photo reprinted from the Marquette University Bulletin 1977-78

MEDIA SPECIFIC SUMMARIES

Photos reprinted from the Michigan Technological University Catalog 1975-76

GENERAL INFORMATION

The final report of the National Workforce Assessment Post-Secondary Education Profile consists of 16 volumes:

1	Air
1	Energy
1	Noise
1	Pesticides
2	Potable Water
1	Radiation
1	Solid Waste
2	Wastewater
3	Composite
1	Private Sector
1	Summary
1	Abstract

Readers are referred to the specific volume for a more in-depth discussion of each area.

The Review Committees are, in the majority of cases, individuals who were met during the on-site process of Phase II. They were nominated by interviewers primarily as a result of their obvious expertise in the field and their evidenced interest in the project. They were not asked to endorse the volume, but rather to review it in draft form and make comments that would improve it.

AIR

SUMMARY

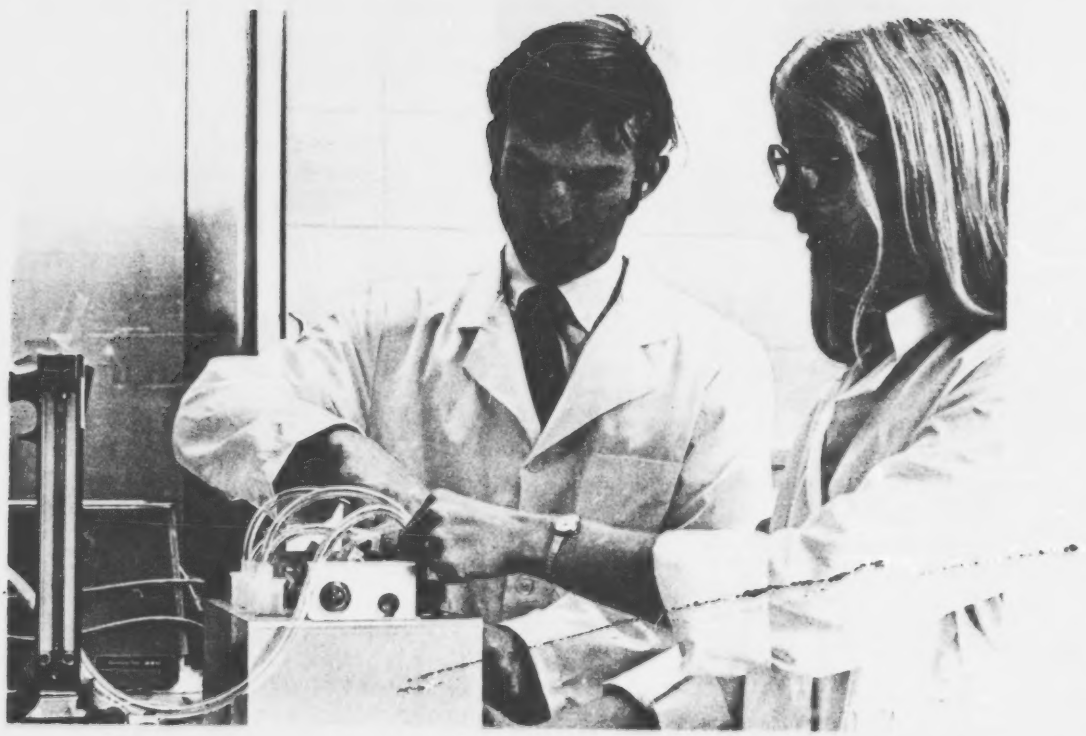

Photo reprinted from the 1976-77 Annual Report, Engineering Experiment Station, College of Engineering, University of Wisconsin, Madison

AIR REVIEW COMMITTEE

A special word of acknowledgement is extended to the following people who graciously gave of their time, knowledge and experience in order to review and comment on the information included in this volume. The efforts of this national committee were particularly insightful, and in general have been incorporated into the final report.

It must be pointed out that in all cases the individuals acknowledged below were asked only to review and comment on the material contained in the volume and to express their views regarding the representativeness of the material presented. They were not asked to endorse either the volume or the study in general, and the inclusion of their name on this list should not be considered an endorsement since such was not the intent.

In light of numerous responsibilities, it is especially important to note that these persons responded within very strict time constraints. Such a pattern reflects positively on both the individuals and the institutions and organizations which they represent.

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STATES, INSTITUTIONS, PROGRAMS AND DEGREES

Forty-five institutions located in 25 states were chosen for on-site visits. They are representative samples of air training programs available in the United States. Fifty programs were described in the program summaries section of the air volume; 48 at the various institutions and two non-degree programs (U.S. Environmental Protection Agency at Research Triangle Park, North Carolina and the Air Pollution Control Association in Pittsburgh, Pennsylvania). Programs varied from short courses to Ph.D. levels of training.

ENROLLMENT STATISTICS AND GRADUATES

The largest student enrollment both for full-time and for part-time students is in the masters program. It is also the degree that has the highest number of graduates. More out-of-state students can be found pursuing graduate level training (masters and Ph.D.). One-third of the programs had students of foreign origin enrolled in their programs. Over half of the programs surveyed had a formalized follow-up manner in which they kept in contact with graduates. Enrollment is stable in most cases, except where the program gained its main emphasis under a training grant. In these cases, students who specialized in air training are on the decline.

FACULTY

Few institutions have faculty members who engage only in the teaching of air courses. Rather, they teach a variety of courses and may have air as their special area of interest. In other cases the emphasis is on research rather than teaching. A wide variety of methods are used by contact people to keep current in the field and include, but are not limited to, professional membership, consulting, teaching and publishing. Responsibilities vary among administration, research and teaching.

CURRICULA

Over half of the contact people at each institution stated that implementation of a course and a new program sequence took a time period that varied between one month and one year. Many opportunities exist within the structure of the post-secondary institution to start new course offerings without the formal mechanism. One that is used extensively is "Special Projects".

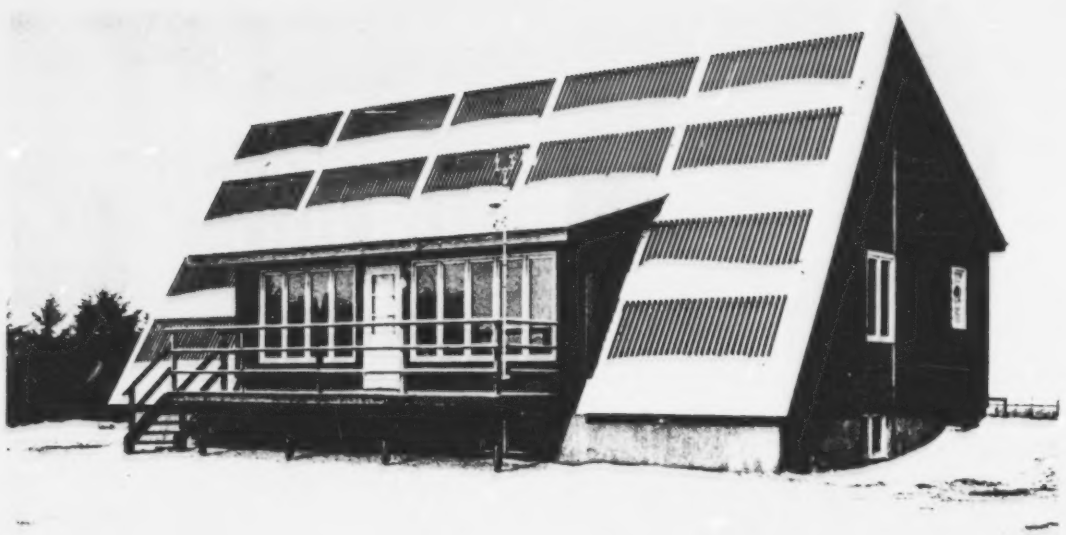
RESEARCH FUNDING AND SOURCES OF STUDENT SUPPORT

In many cases student support is available because of public or private research funding. Sources include, but are not limited to, the Environmental Protection Agency, National Science Foundation, state departments of Health and Environmental Control, and the U.S. Corps of Engineers. Some sources of private funding mentioned were General Motors, General Foods, American Iron and Steel Institute.

EMPLOYMENT

Students who have participated in an internship/applied study term have a slight edge upon graduation in the job market. Nineteen of the 48 programs surveyed had this option available to students. Four general areas of employment exist--industry, consulting, government, and other. The majority (65%) of associate graduates are employed in government positions. In the remaining four degree levels (bachelors, masters, engineer, doctoral) private sector employment (industry or consulting) gains the largest number of employees. Government--local, state or federal--employment hovers around 35% for all degrees except the bachelor. Government employment on that level is 22%.

ENERGY SUMMARY



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ENERGY

STATES, INSTITUTIONS, PROGRAMS AND DEGREES

Energy education programs offered by more than 30 schools in 18 states were surveyed in Phase II. Because several schools offer more than one program, the report includes in excess of 40 programs in which 95 certificate or degree sequences are available.

ENROLLMENT STATISTICS AND GRADUATES

Among the associate degree programs, 80 to 100% of the students are in-state. Among the bachelors programs, most range from 70 to 80% in-state; the high is 98%, the low 33%. Graduate enrollments range from a high of 75% to a low of 20% in-state; most programs reported fewer than 50%.

Total program enrollment varies from fewer than 10 to more than 600. Nearly 60% of the students are in bachelors programs; of these, 99.5 are full-time. Associate degree programs account for slightly more than 3% of the full-time employment. Fewer than 5% of the students in energy education programs surveyed are women.

FACULTY

Altogether, 231 (58%) full-time program faculty and 165 (42%) part-time (home-based in other departments) were recorded. Approximately half the programs rely exclusively or nearly so on full-time program personnel; several programs are made up of a core program faculty supplemented by several people cost-centered in other departments. Several multidisciplinary efforts are staffed by one person with coordinating responsibilities and a large number of faculty whose program participation may vary from active participation in administration, student advising, and curriculum decisions to assuming responsibility for teaching a single course infrequently.

CURRICULA

Programs in the report include well-established programs in nuclear engineering, and mining petroleum and natural gas technology and engineering. Additionally, there are unusual programs in energy conversion, energy resources management, and several others which represent recent innovative approaches to a broad spectrum of energy problems.

Several programs indicated internships or applied study terms are an integral component of the educational experience. Many singled out the applied study aspect as the most important component distinguishing their program from similar efforts.

The need for additional curriculum materials appears to be of little concern except at the associate level. Faculty complained both of materials that are above and below the reading or technical level of associate degree students.

Respondents representing engineering programs often replied that communication skills are a problem of incoming students; there is some disagreement as to how well the problem is dealt with. Associate program faculty felt the level of communication skills of many of their students is a problem of major significance.

RESEARCH FUNDING AND SOURCES OF STUDENT SUPPORT

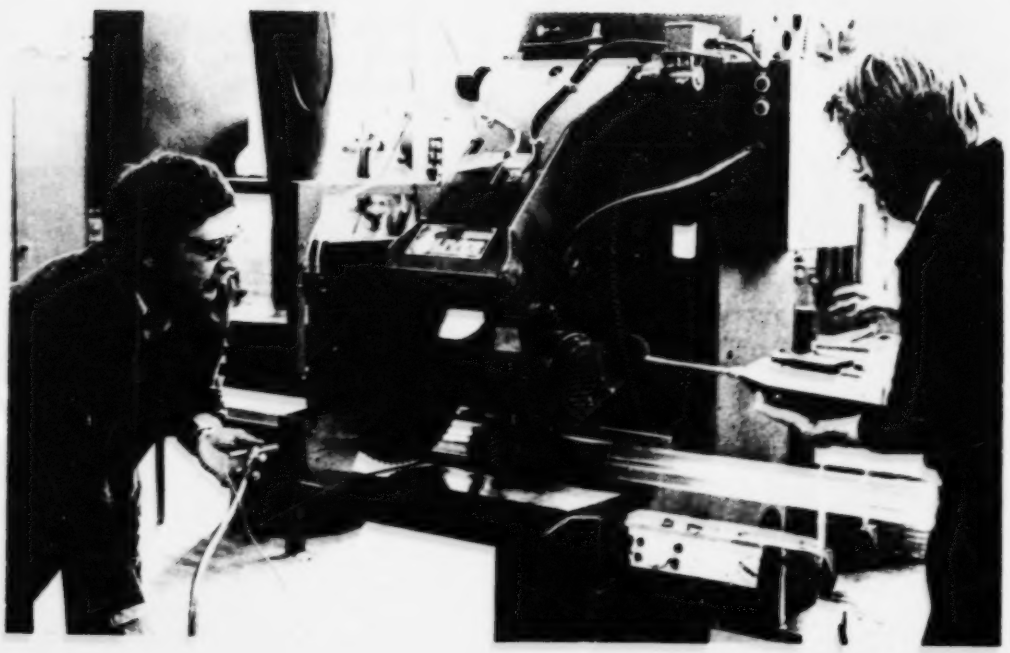
Energy research support is widespread. As would be expected, the U.S. Department of Energy is the most prevalent source of research money. Other federal sources most commonly cited were the U.S. Bureau of Mines; the Environmental Protection Agency; the Department of Health, Education and Welfare; and the Nuclear Regulatory Commission. Many state agencies support projects.

EMPLOYMENT

Overall employment opportunities in energy related occupations are extremely good. Graduates of the associate program discussed in the report are employed as coal miners or as technicians in other energy industries. The majority of the programs at the bachelors level require an internship or have an active applied study option which faculty feel provides graduates with a significant advantage in the job market. Masters and doctoral students are often either currently employed or have returned to school to prepare for a specific type of job. Only in the nuclear industry is the optimism regarding employment somewhat guarded.

At the associate level, virtually all graduates find employment in industry; of those with bachelors degrees 76% are employed in the private sector, and 18% in the public sector. Masters employment data shows 72% in the private sector, 63% in industry, 9% as consultants, and 26% in the government sector. Doctoral employment data shows 33% in the private sector (22% in industry, 11% as consultants) and 38% in the government sector.

NOISE
SUMMARY



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NOISE REVIEW COMMITTEE

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NOISE

STATES, INSTITUTIONS, PROGRAMS AND DEGREES

Noise-related training programs were reviewed in eight states, and in eleven agencies/institutions. Nine of the programs are offered by educational institutions, and offer academic degrees, with the majority of these programs being offered at the graduate level.

Six of the degree programs are associated with engineering departments; a seventh is housed in a department of industrial environmental health sciences, but offers a strong engineering emphasis. These programs focus on acoustics, and noise and vibration control (to varying degrees and with different emphases). The remaining two degree programs offer graduate degrees in audiology (one specifically in industrial audiology); these have noise control aspects in their curricula.

The two non-degree noise programs reviewed include a course in audiometric orientation for industrial hearing conservationists, and a group of courses offered by a state agency in noise control.

ENROLLMENT STATISTICS AND GRADUATES

Fifty-four percent of the 188 students in the degree programs surveyed are earning the master's degree (enrollment figures are not applicable/not available for two programs). Thirty percent of the students are earning a doctoral degree, while 16 percent are taking a bachelor level noise course sequence. Most of the programs recruit students by such means as distributing descriptive materials on campus and in other institutions, by visiting other institutions, and by maintaining visibility at national meetings and conferences. In-state students predominate, ranging from 60 to 80 percent of those enrolled.

Of the annual graduates from these programs, 37 percent complete the bachelor's degree noise requirements, 47 percent complete a master's degree, and 16 percent earn the doctorate. Forty-one percent of the degree programs have reported increasing enrollment over the last three years, while 59 percent have experienced stable enrollment.

FACULTY

Sixty-nine full-time and eighty-eight part-time faculty serve the noise-related degree programs surveyed. They have varying levels of interaction with the programs, and many classified as part-time for these programs are full-time with another department. Faculty responsibilities vary among administration, research, and teaching.

CURRICULA

The acoustics/noise control degree programs surveyed generally offer courses in theoretical and applied acoustics, vibration, acoustical and mechanical measurement, and noise and vibration control. They often also offer some more specialized courses including aero-acoustics, environmental noise management, underwater acoustics, architectural acoustics, effects of noise and vibration on humans, and engineering acoustics. The audiology programs concentrate chiefly on human factors (anatomy and physiology, aural rehabilitation, clinical practice, and psychological acoustics) and measurement and calibration. They include courses in hearing conservation for industrial settings and the general environment. Four of the degree programs include an applied study term as an integral part of the curriculum, and two more plan to offer such opportunities.

It was found that in most cases a complete change in a course can be implemented in from less than one month, to one year. Some respondents reported similar time frames for a program change, although nearly one-half reported that such changes take from one to two years to effect. Curriculum materials which were felt to be lacking include textbooks giving thorough treatment of acoustics, audiology, and noise control engineering.

RESEARCH FUNDING AND SOURCES OF STUDENT SUPPORT

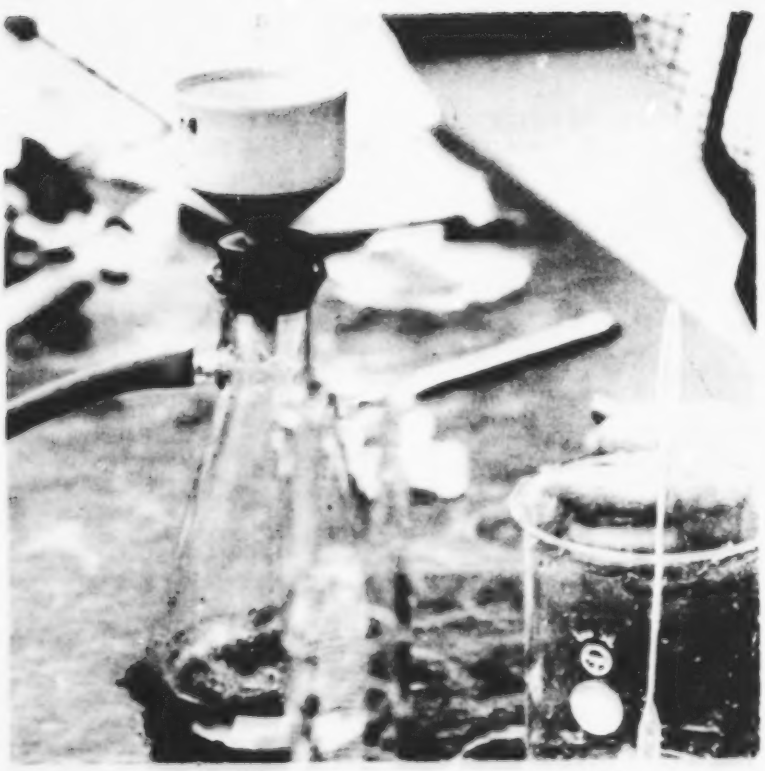
The most common form of financial assistance to students in these programs is the research assistantship. Limited scholarships and fellowships are available in most programs. While federal training grant monies are available for students in audiology, sources indicated no knowledge of similar funding for students in acoustics/noise control; a number of these sources expressed the need for such.

Most programs are highly dependent upon external funding for continued growth, and the development of new technologies. Limited foundation support is available, and federal research monies appear to be decreasing. Several programs receive more research funding from private industry than from governmental agencies. A number of officials indicated that the noise control field is being underserved with respect to research.

EMPLOYMENT

Data indicate that overall, 48 percent of the graduates of these programs enter the private sector, chiefly industry; 30 percent become employed by governmental agencies; and 12 percent enter other employment sectors, mainly academia. According to sources, bachelor students who have completed a course sequence in noise are qualified to fill the noise-related occupations of acoustical engineer, noise control specialist, and industrial engineer. Master's and doctoral graduates in acoustics/noise control are qualified to enter the above occupations, as well as those of noise and vibration control engineer, and noise control consultant. Those completing a doctoral degree may also be qualified for the occupation of acoustical physicist. Graduates of the audiology programs may enter the noise-related occupations of industrial audiologist and occupational hearing conservationist. Nearly all of the officials interviewed believe that the future demand for noise control professionals will increase, but the lack of regulatory legislation and the paucity of funds will hinder the meeting of these needs.

PESTICIDES
SUMMARY



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1977-78

PESTICIDES REVIEW COMMITTEE

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PESTICIDES

STATES, INSTITUTIONS, PROGRAMS AND DEGREES

Pesticide and toxicology-related training programs were reviewed in twenty-one states and in twenty-six academic institutions. Considerable variance in size, description, and extent of topic coverage was observed. The thirty-four programs surveyed range in academic level from that of the certificate and diploma to that of advanced degree. Three programs included in the study were considered non-institutional and were not degree granting. The institutions which offer these programs included community colleges, private colleges, and state universities.

ENROLLMENT STATISTICS AND GRADUATES

Although a small number of programs report they have no need for formalized recruitment, the majority employ one of several methods. Such strategies include: forwarding descriptive materials to other institutions (i.e., posters, brochures, etc.), making personal responses to prospective students' inquiries, making contacts at national meetings and in industrial settings, and maintaining registry in the Peterson's Guide to American Colleges and Universities.

Ninety-five percent of the associate level entrants remain in their native states to pursue degrees, as compared to a low of 41 percent in-state enrollment at the doctoral level.

There are a total of 924 students enrolled in these programs full-time. Pest control programs account for 828 of these students; 147 at the associate level, 374 at the bachelors level, 236 at the masters level, and 71 at the doctoral level. Each year approximately 25 percent of the total enrollment graduates. There are 98 students enrolled in toxicology programs; 42 at the bachelors level, four at the masters level, and 52 at the doctoral level. Approximately one-third of these students graduate annually.

FACULTY

Three hundred and sixty-nine part-time faculty and 251 full-time faculty conduct these programs. Their responsibilities vary in substance among teaching, research, and administration.

In response to a question asked of them as to how they keep up with the new developments in their fields, affiliations with professional associations (i.e., reading their journals and attending their national and regional meetings) were most often cited. They also found carrying out research, reading professional papers, keeping contact with colleagues at other institutions, teaching courses, and consulting to be important in staying abreast of changes which occur in their respective fields.

CURRICULA

The pesticides certificate/associate programs focus on pest control technology, and represent several approaches to the field, including agricultural pest control, urban pests management, and plant protection. Bachelor level programs are nearly evenly divided between the classifications of entomology and pest management. Graduate curricula have also been clustered according to academic emphasis like the bachelors programs, pest management and entomology, though offering more advanced and specialized courses. Of the seven toxicology programs surveyed, one is offered at the bachelor level, with a concentration in environmental toxicology. The remaining six toxicology programs are offered at the graduate level, and within the majority of the programs the student has a choice of concentrations, including: environmental toxicology, neuro-behavioral toxicology, or radiation toxicology.

In some cases, students are able to receive on-the-job training in the form of applied study, internships, or co-op plans. Five of the programs have mandatory internships associated with their degree requirements, and another eight offer students the choice of participating in an applied study experience or not.

Faculty members were asked to identify time constraints necessary for making changes both in a single course and in an entire program. Courses are commonly added under the title of "Special Problems" or "Special Topics" until they are channeled through the appropriate ranks for approval and inclusion in the catalog. The date of catalog publication is influential also in deciding how quickly changes may be effected. Most faculty conclude that it takes from one month to one year to establish such changes officially.

Communication skills of these students were for the most part considered to be deficient and remediation most often takes the form of extensive report writing, essay style examinations, and technical writing courses.

RESEARCH FUNDING AND SOURCES OF STUDENT SUPPORT

The most prevalent form of financial assistance offered to graduate students is the research assistantship, followed by the teaching assistantship. Associate level students have little in the way of financial help outside of loans. Bachelor students have both loans and scholarships open to them. Research monies at the graduate level are of primary importance; so much so that in one program the salaries of nearly all the faculty come from research funds.

EMPLOYMENT

In some cases employment data were "best estimates"; in other cases they were provided from actual follow-up surveys. Data show that graduates return to the academic community at a rate of 31 percent following graduation. Fifty-four percent of the master's graduates are employed in the private sector, 27 percent in government, and 15 percent return to academia. Most commonly, bachelor's graduates find employment in the private sector, i.e., 48 percent; and associate graduates are most likely to be employed in the industrial sector with commercial pest control agencies. Sources were also asked to provide the titles of occupations for which their graduates are considered qualified. Samples of titles which were provided include the following: Pesticide Applicator, Entomologist, Epidemiologist, Regulatory Specialist/Supervisor, Pest Control Consultant, Teacher, Researcher, among others.

POTABLE WATER SUMMARY

Photos reprinted from the
Northland College Catalog
1975-76

POTABLE WATER REVIEW COMMITTEE

(Potable Water I - Single Degree Programs Potable Water II - Multiple Degree Programs)

A special word of acknowledgement is extended to the following people who graciously gave of their time, knowledge and experience in order to review and comment on the information included in this volume. The efforts of this national committee were particularly insightful, and in general have been incorporated into the final report.

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In light of numerous responsibilities, it is especially important to note that these persons responded within very strict time constraints. Such a pattern reflects positively on both the individuals and the institutions and organizations which they represent.

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POTABLE WATER

STATES, INSTITUTIONS, PROGRAMS AND DEGREES

The National Environmental/Energy Post-Secondary Education Profile includes 101 potable water post-secondary programs. In all, 77 institutions, from 33 states, are represented. The programs vary in size and in description from operator training at the local level, to advanced degree programs offered within the universities.

Due to the extensive number of program summaries, the report on potable water post-secondary programs is presented in two volumes. The Potable Water Volume I contains all single degree programs. The multiple degree programs are presented in Potable Water Volume II, (i.e., programs leading to bachelors, masters and doctoral degrees).

ENROLLMENT STATISTICS AND GRADUATES

The majority of the programs presented in the potable water volumes enroll from three to 20 full-time students. The range, however, varies from as few as one to as many as 530. Part-time students are reported by 44% of the programs and range from one to 500. Part-time students are predominantly represented at the certificate and masters degree levels.

Graduates per year range from less than one to 185. The majority (52%) of the programs in the potable water volumes are characterized by from one to ten graduates per annum. Graduate placement and follow-up were a major area of interest on the part of the project staff. Overall, 70% of the programs currently utilize some form of graduate follow-up.

A review of the data shows that 47% of the potable water programs are characterized as stable regarding graduates and enrollment. While 45% of the programs reported increasing student enrollments and graduates per annum, a slight downward trend was indicated by 8% of the programs.

FACULTY

The faculty represented in the potable water volumes totals 1,082 persons. Of the total, 802 or 74% were reported as full-time, while 280 or 26% were reported as part-time. Departmental size ranged from one to 280 full-time faculty members, and from one to 40 part-time members. No attempt was made to develop a faculty-student ratio, as a ratio of this nature was deemed less than meaningful for several reasons. Specifically, some faculty were engaged primarily in research or in administrative duties. In addition, some faculty were not cost-centered through the department, and/or others were responsible for an overload of courses.

CURRICULA

Programs that address the educational needs of students at the certificate and associate degree levels illustrated a core curriculum concentration including chemistry, biology and microbiology, with fundamental instruction in water supply and treatment plant operations.

The preponderance of the baccalaurate programs presented in the volumes are associated with civil or environmental engineering departments. Course work included strong emphasis on the physical and natural sciences. Core requirements usually included courses in design, operation and maintenance of water treatment plants, water analyses, environmental health, and applicable environmental engineering.

Graduate level curricula complement the undergraduate preparation. Graduate students, however, are offered intensive studies in design and operations of water treatment and supply facilities through advanced and rigorous course work and research.

Some form of internship was a component of 27% of the surveyed programs. While 71% reported no internship, 2% were unable to supply the information. Personnel interviewed, however, described the internship as an increasing area of importance. Many personnel reported the addition of an internship as future program components.

RESEARCH FUNDING AND SOURCES OF STUDENT SUPPORT

Research funding and student support play a vital role in the quality of education at the majority of the institutions visited. Research monies are available from a variety of sources, both public and private. Federal agencies such as the U.S. Environmental Protection Agency, National Science Foundation, National Institute of Health and the Army Corps of Engineers, support a substantial amount of research at many of the major universities. State and municipal agencies also contribute a significant amount of money for research activities at local institutions. Private industry research grants and private consulting contracts generate the majority of the private sector funding.

EMPLOYMENT

Graduates of the certificate and associate degree level programs were reported as predominantly entering public sector employment. The preponderance of bachelors, masters, and doctoral degree graduates were identified as entering the private sector. Programs represented in the potable water volumes at the certificate, diploma or associate level, described graduates as encountering few problems associated with procuring employment in the field often with municipal water supply and/or treatment facilities.

Baccalaurate graduates were described as often seeking employment for several years prior to returning to environmental graduate programs. The employed graduates holding advanced degrees were predominantly products of environmental or sanitary engineering programs. Overall, the majority of the graduates found employment in their field of study.

RADIATION SUMMARY

Photo reprinted from the 1976-77 Annual Report, Engineering Experiment Station, College of Engineering, University of Wisconsin, Madison

RADIATION REVIEW COMMITTEE

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RADIATION

STATES, INSTITUTIONS, PROGRAMS AND DEGREES

Examined in Phase II of the National Environmental/Energy Workforce Assessment were twenty-five academic radiation training programs which are located in fourteen states. Training programs contacted ranged from the certificate level to advanced degree programs and included those programs offered by engineering, public health and science oriented schools.

ENROLLMENT STATISTICS AND GRADUATES

Twenty-two programs provided information describing thirty-seven different types of recruitment techniques that they employ. Mostly in-state students are enrolled in associate and bachelors degree programs and including foreign students, at the masters degree level, out-of-state students predominate in radiation enrollments. Of twenty-seven programs responding to requests for information on graduate follow-up, twenty (74%) had some method of following up where their students were obtaining employment.

FACULTY

A total of 20% full- and part-time faculty members serve the twenty-seven radiation training programs described in this volume. Approximately 72%, or 160, are full-time and 28%, or 63, are part-time.

CURRICULA

At the associate level, students are introduced in many of the programs described in this volume to principles of health physics, instrumentation and other aspects of engineering technologies. Baccalaureate students in this field of engineering or science are directly concerned with the release, control and safe utilization of nuclear energy. Advanced degree candidates are provided greater opportunities for study involving fundamental research, industrial applications, and community health aspects of radiation protection. Applied study terms are a very active and integral (though usually not required) part of many of the radiation training programs. In the radiation area, 14 of the 27 (52%) programs offer work-study. Of forty degree programs, seventeen (43%) said that it took between one month to one year to implement course content changes, and between one to two years to implement content changes in a program.

RESEARCH FUNDING AND SOURCES OF STUDENT SUPPORT

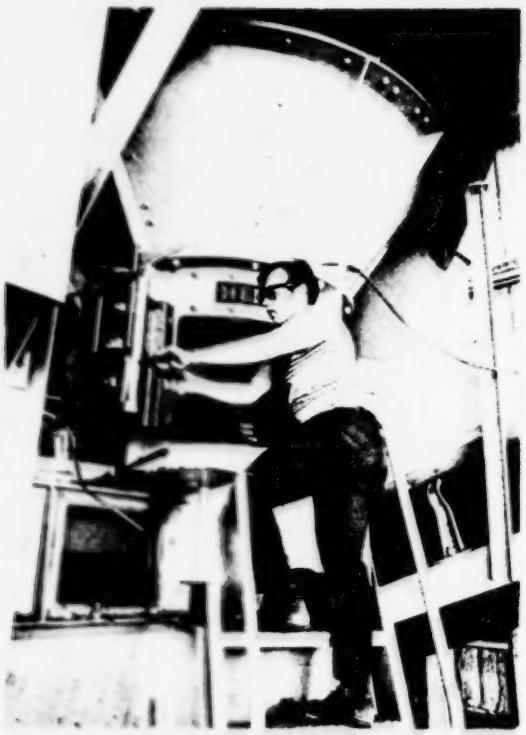
The radiation programs included in this study receive a diversity of funding and the most common sources are the U. S. Department of Energy, the Nuclear Regulatory Commission, the National Science Foundation, and the Electric Power Research Institute. Graduate teaching and research assistantships were most often cited as the major financial source for students by nine programs (39%). Internship and co-op programs are utilized by seven institutions (30%).

EMPLOYMENT

At the associate degree level, 65% of the graduates obtain government positions whereas 53% of baccalaureate graduates find private sector positions. Advanced degree graduates find positions of almost equal percentages in private, governmental and other areas.

Occupations held by associate degree graduates often include those of health physics monitor and technician, and radiologist technician. Graduates holding baccalaureates often find jobs as radiological health specialists, radiation physicists, radiation inspectors and nuclear instrumentation/control technicians. Advanced degree graduates in this field are usually qualified for positions including medical radiation physicist, radiation physicist, radiological health specialist, and radiation engineer.

SOLID WASTE
SUMMARY



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SOLID WASTE REVIEW COMMITTEE

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SOLID WASTE

STATES, INSTITUTIONS, PROGRAMS AND DEGREES

Educational programs in solid waste management offered by 16 schools in 9 states were surveyed during Phase II. As some schools offer more than one program, a total of 18 programs through which 44 certificate or degree sequences are available were included. Two programs that have been discontinued are discussed because their content and fate are of significant relevance to the field. Programs included represent associate through doctoral work.

ENROLLMENT STATISTICS AND GRADUATES

Only four programs in the report (all graduate level) have foreign students enrolled. In-state undergraduate enrollments characteristically exceed 80% of the total. The graduate level profile is extremely variable, ranging from an out-of-state low of 10% to a high of 90%.

Although respondents in Phase I stated explicitly that the greatest need in solid waste management is for persons trained at the operator/landfill manager level, only two extant programs in this report are of that type. Two others included are no longer functioning due to lack of students and support.

FACULTY

Most programs in this sample depend wholly or largely upon faculty who are full-time within the program. Three programs are fairly evenly divided between full-time program personnel and persons based in other departments; three depend wholly, or nearly so, on other department-based faculty designated as part-time with regard to the solid waste program.

Overall, 116 (48%) faculty are full-time in programs with solid waste sequences; 124 (52%) are part-time. This ratio is somewhat distorted because the three programs which depend heavily upon other department-based faculty are large, faculty-wise, totaling 97 persons (78% of all part-time program faculty.)

CURRICULA

The curricula of solid waste educational programs reflect the current national emphases in solid waste management as delineated in the Resource Conservation and Recovery Act of 1976. Reduction of solid waste volume, safe disposal of hazardous wastes, resource recovery, and waste-based power generation are major components of curricula at all levels. Most slighted in our approach is a concerted effort to train a competent workforce for jobs requiring less than a bachelor level education. The bulk of the programs in the report are integral parts of established engineering programs or are multidisciplinary efforts which were generated in engineering departments.

RESEARCH FUNDING AND SOURCES OF STUDENT SUPPORT

Data from Phase II indicate that the most prevalent form of financial assistance to graduate students is through research funding support. Research assistantships and project employment are common. Such support is available through grants provided by such federal agencies as the Environmental Protection Agency, National Science Foundation, National Institute of Health, and the Army Corps of Engineers. State and municipal support is substantial.

EMPLOYMENT

Employment opportunities in Solid Waste management appear to be generally good; particularly so for engineering-related occupations. Although persons in the field have stressed that a great need exists for persons trained at the associate level, educational programs addressing this need are minimal. The bulk of the graduates of programs included in the report are bachelors level engineers; it could not be determined what percentage of these found employment directly related to solid waste management. Much the same holds true for masters and doctoral graduates, although they comprise a much smaller portion of the sample. Only one masters level certificate program could be shown to be placing the majority of the graduates in solid waste management positions.

WASTEWATER

SUMMARY

Photo reprinted from the Northland College Catalog 1975-76

WASTEWATER REVIEW COMMITTEE

(Wastewater I – Single Degree Programs Wastewater II – Multiple Degree Programs)

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WASTEWATER

STATES, INSTITUTIONS, PROGRAMS AND DEGREES

The wastewater report details 105 post-secondary educational programs. In total, there are 88 institutions from 33 states represented. The environmental programs presented range from operator training to advanced degree programs offered within universities. The wastewater report is presented in two volumes due to the extensive number of program summaries identified for this environmental area of the study. Wastewater Volume I contains all single degree programs. The multiple degree programs are described in Wastewater Volume II.

ENROLLMENT STATISTICS AND GRADUATES

Enrollment statistics which include full- and part-time students, average number of graduates per year, and changes in enrollment and graduates are, for the most part, estimates made by the program persons interviewed. Full-time enrollment in the certificate programs ranged from four to 185. Overall, only 13% of the total students enrolled in certificate programs were full-time, while 87% were classified as part-time. Part-time enrollment at this level ranges from three to 500.

At the associate level, 90% of the students were reported as full-time, while 97% of the baccalaureate students were categorized as full-time. At the graduate level, 64% of the masters level students and 96% of doctoral students were identified as full-time students.

The certificate and masters level programs illustrated the highest percentage of part-time students, indicating that many students return to school for further training while maintaining employment in their field. Graduates per annum range from less than one to as many as 185.

The majority of the wastewater programs, 54%, are characterized as stable regarding enrollment and graduates. An upward trend was noted in 27% of the programs. Only 8% of the programs were described as illustrating a decrease regarding enrollment and graduates.

FACULTY

Total faculty, as depicted in the two wastewater volumes, included 1,106 persons from the 88 institutions visited. Full-time faculty comprised 73% (802 members); and, part-time faculty comprised the remaining 27% (304 members).

Department size ranged from one full-time faculty member to 280 (in one program). Part-time faculty ranged from less than one to 52. The majority of the faculty interviewed, both full- and part-time, devote time and effort to research, consulting and advisory activites in addition to their regular program responsibilities. The majority of the faculty members interviewed held memberships in a variety of professional organizations. Many of these personnel also contribute time to national advisory committees.

CURRICULA

Wastewater programs vary from school to school, although many similarities in program structure and curricula were noted. Many of the certificate and diploma programs concentrate on upgrading and certification of persons already employed in the field. The associate degree programs, for the most part, educate and train personnel for entrance into the field and require hands-on experience in treatment plants. General courses in chemistry, math and microbiology plus fundamental instruction in wastewater treatment plant operations usually comprise the core curricula of these programs.

Programs presented in the wastewater report at the baccalaureate level were predominantly components of civil or environmental engineering departments. Requirements usually include a strong background in the physical and/or natural sciences.

Graduate level wastewater programs generally interface and complement the undergraduate programs. However, individual flexibility and often a wider variety of course offerings encourage specialization at this level.

RESEARCH FUNDING AND SOURCES OF STUDENT SUPPORT

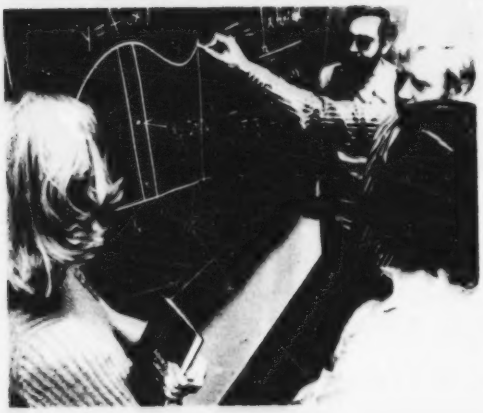
Research funding and student financial support is derived from a variety of sources both public and private. The U.S. Environmental Protection Agency provides a substantial number of research grants to many of the major institutions. It was noted that both the number and the amount of these funds is on the decline. Training monies for wastewater programs were characterized as the most dramatically reduced source of funding, especially at the community college level.

The majority of research funding appeared to be directed towards graduate level research. These research grants often support both faculty and students. Student support at the graduate level is usually directly dependent upon the number of acquired research grants and contracts. Research assistantships are the most widespread form of financial assistance for graduate students. At the undergraduate level, financial assistance usually takes the form of the traditional financial aid packages.

EMPLOYMENT

Graduates of the wastewater programs, at all levels, were described as facing few obstacles to gaining employment in their field. Graduates of less than four-year institutions predominantly enter public sector employment. Graduates from wastewater certificate and associate degree programs, obtaining positions in the public sector, usually enter at the wastewater operator or technician level.

Graduates of bachelors, masters and doctoral degree programs tended to select private sector employment. The major reason reported was higher salary levels offered by the private sector. In addition, many doctoral graduates sought employment in teaching and administration at the post-secondary level.



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COMPOSITE SUMMARY

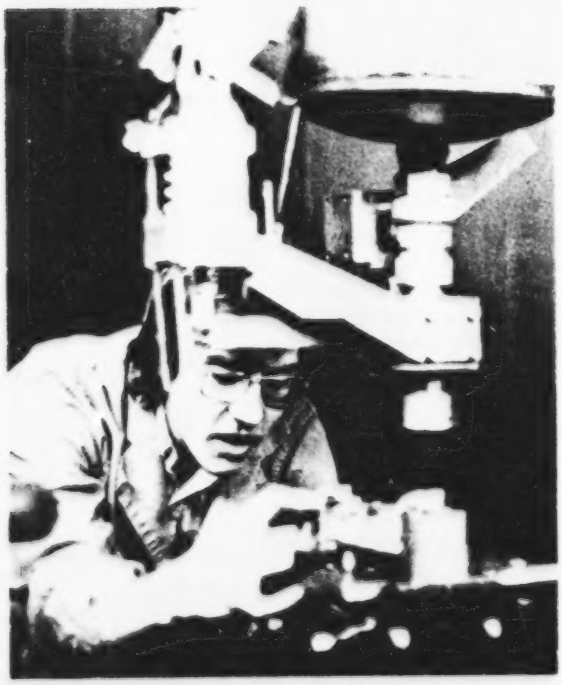

Photo reprinted from the 1976-77 Annual Report,
Engineering Experiment Station, College of Engineering,
University of Wisconsin, Madison

COMPOSITE REVIEW COMMITTEE

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COMPOSITE

STATES, INSTITUTIONS, PROGRAMS, AND DEGREES

The Composite category accomodates those programs whose focus, structure, curriculum content, and specialized options indicate an overlapping emphasis in two or more environmental areas surveyed in Phase II or whose emphasis is environmentally related but not specific to any one area. This category is further divided into Engineering/Health and Education/Ecology sections; the former reflects a more technological emphasis while the latter integrates coursework in the natural, physical, and social sciences. This conceptual split in the composite category was intended to generate a more interpretable data base; however, the differences between the two sections are not substantial.

The Post-Secondary Education Profile (Phase II) surveyed 93 Engineering/Health programs in 32 states and 37 Education/Ecology programs in 17 states. In total, these programs represent a wide spectrum of degree offerings -- from the diploma to the doctorate -- and curriculum options.

ENROLLMENT STATISTICS AND GRADUATES

National summaries of enrollment and graduates per annum for the Composite programs indicate that approximately three-fifths (58%) of the graduates in the Composite programs are awarded degrees at the bachelors level. Enrollment statistics indicate that 54% of the Composite programs are experiencing stable enrollment and 34% are sustaining growth.

Percentages of in-state/out-of-state/foreign students show a fairly linear increase by degree level. That is to say, graduate programs have higher numbers of out-of-state and foreign students than undergraduate programs.

Recruitment techniques are relatively standard across these composite programs and include posters, brochures, visits to local high schools, and campus career days. Those programs with extensive facilities, traineeships, or other curricular or financial attractions find that such inducements facilitate recruitment. The effectiveness of any one method is difficult to assess across programs and is undoubtedly the function of many intervening variables.

FACULTY

A total of 992 (62%) full- and 610 (38%) part-time members serve the 130 composite training programs surveyed. Of these, 832 (68%) full and 383 (32%) part-time faculty are associated with engineering/health programs and 169 (43%) full and 227 (58%) part-time faculty are working in education/ecology programs. In several programs, a number of departments supply faculty to teach various courses in the composite programs.

When asked how they remain current in their field, faculty responses were largely the same -- journals, professional meetings, and consulting. A number of contact persons noted the difficulty of keeping abreast of the rapid changes in the environmental field and observed the need for periodic, easily obtainable up-dates on environmental research and regulations.

CURRICULA

Programs in the Engineering/Health section prepare students in at least two of the eight environmental areas surveyed in Phase II (air, energy, noise, pesticides, potable water, radiation, solid waste, and wastewater). The emphasis of the programs is primarily technical and/or scientific and, as reflected in the section heading, geared to environmental engineering and environmental health coursework. The Education/Ecology programs train students for social, educational, political, ecological, managerial, and systems positions within the environmental workforce. The curricular emphases of both sections are not easily isolated, and the assignment of programs to a particular section is somewhat subjective.

To provide students with a practical working experience related to their classroom and laboratory training, 29% of the Engineering/Health and 59% of the Education/Ecology degree programs offer internships or applied study terms. These experiences not only prepare students for real-world employment but may facilitate job placement. Salaries paid for work under these instructional programs are also a means of financial aid.

RESEARCH FUNDING AND SOURCES OF STUDENT SUPPORT

The financial stability of environmental programs is often a key to their success or demise. Monies for research and student financial aid enable programs to attract faculty and students. Federal and state agencies, private corporations, regional study commissions, and other entities provide important research funding to the programs surveyed in Phase II.

Student financial aid packages typically include scholarships; federal, state, and campus loan programs; college work study; and part-time employment outside the university. A majority of graduate students in many of the programs are employed by their departments as teaching or research assistants or as support personnel on program grants or contracts. Traineeships, such as those from the Environmental Protection Agency and the National Institute of Occupational Safety and Health, are an important means of support for those programs fortunate enough to receive them; many other contacts note the negative impact the loss of these traineeships has had on the stability of their programs.

EMPLOYMENT

Contact personnel were asked what percentage of their program graduates are employed in industry, consulting, government, or other fields (teaching positions, etc.). Industry and government appear to draw greater numbers of Engineering/Health and Education/Ecology program graduates than do consulting firms and various educational institutions. The high percentage of graduates entering government work is not surprising given the emphasis placed on environmental regulation, assessment, and protection by the public sector. Likewise, government mandates have forced industry to take steps in combating pollution and have participated employment opportunities in this area. Declines in public school enrollment and fiscal constraints at all levels have contributed to decreasing numbers of jobs in the educational community.

BUSINESS & INDUSTRY

AND

TRADE & PROFESSIONAL

ASSOCIATIONS

BUSINESS & INDUSTRY AND TRADE & PROFESSIONAL ASSOCIATIONS

The Business and Industry, Trade and Professional Associations portion of the National Environmental/Energy Workforce Assessment describes 64 training programs related to pollution control and abatement, environmental research and resource conservation. The organizations included in this survey represent a variety of businesses, and trade and professional associations.

A wide variety of organizations responded to this survey, including major oil companies, noise consulting/training firms, utility companies, major manufacturers and numerous types of associations. The training done by such a diverse group varies greatly in format, presentation, and, of course, content and scope. The types of courses and their methods of presentation include seminars using rather conventional workshop materials; correspondence courses which are by nature individualized; audio-visual training programs; computer modelling programs used as basis for noise training; and multi-faceted, plant-wide, conservation programs which utilize all types of media. Actual program summaries included in the report provide detailed information about each of the 64 training programs.

OBJECTIVES AND PROCESS

Broadly stated, the objectives of this portion of the Assessment begin to reveal answers to the following questions about private sector training: who, what kind, with what types of materials, for whom, and why. In order to gather data about private sector training, 375 letters were sent to various businesses, and trade and professional associations. Those organizations which responded and sent training materials for review are included in the report. Criteria for inclusion generally related to program completeness (that is, printed materials exist for the training; it is not an informal, on-the-job training program) and applicability to the eight environmental areas being surveyed.

THE RESULTS

While the sample is small, it represents the various types of training being conducted in the private sector as well as providing very specific information about such training efforts:

- "Training" encompasses specific skills and information, environmental awareness, global issues, resource conservation, health hazards, computer modelling, emergency preparedness, current environmental issues and regulations as well as new technology.

- The recipients of this training are primarily employed by the private sector but in some cases include high school students, public sector employees and the community at large.

- The cost of this training is borne by the private sector.

- The training programs were developed because of a specific need whether it be the passage of new legislation, the discovery/invention of new technology, a need for conservation or to reduce the risk of pollution.

- Training or retraining by the private sector versus academic training in environmental fields is the subject of much debate and varying opinions. The controversy over the preparation of individuals for environmentally related positions may be industry-specific but needs further investigation.

A great deal remains to be learned about training in the private sector. This sample attempts to answer some basic questions and in the course, raises more questions.

PROJECT

COMMENTARY

Some general comments surfaced during this phase of the National Environmental/Energy Workforce Assessment.

- The withdrawal of federal support was consistently mentioned as the factor that was most instrumental in the reduction of the programs and/or the number of students enrolled. Contact people felt that for continued growth in the environmental areas, federal support would need to be forthcoming and consistent. Concern was expressed at the lack of firm commitment to a program that results from the use of "soft" money on which to lay the program foundation. More reliable, consistent support was needed.

- It is felt that the Environmental Protection Agency has a bias in favor of engineering programs and those more technically oriented, and is not supporting equally important programs with sufficient commitment (e.g., environmental health).

- Schools are feeling less able to organize their programs by specific environmental areas now that training grants are no longer as plentiful.

- Two year schools are often at a disadvantage because facilities, support faculty, and equipment are lacking, especially in comparison to large colleges and universities, unless they have consistently received outside funding, such as that from the Environmental Protection Agency.

- Some graduate programs are noticing that there is a decline in the number of students applying for admission. They attribute this, in particular, to the higher salaries offered by industry for graduates with bachelor's degrees. Students commonly pursue advanced training on a part-time basis.

- Applied study/internships are encouraged because of the professional contacts which result, the "hands-on" potential, and the valuable work experience. These experiences are often considered to be the most worthwhile and successful part of a given program.

- While environmental studies are growing and increasing in number, their actual enrollment is still small. They are more interdisciplinary in nature, and have a small number of faculty supplementing their teaching staff from other departments. Contact people see the ability to write environmental impact statements as one of their major curriculum strengths.

- Students need help with their communication skills. The development/remediation of students' communication skills, and lack thereof, should not be delayed until college (as officials feel is now the case); rather, they should be attended to at the secondary level and earlier.

- Industry and education need to align their efforts to establish internships which give marketable skills priority, and also to ensure a commitment that graduates with the skills they have identified will be employable. Industrial advisory boards have proven to be very helpful, not only from the public relations point of view, but also for placement of graduates.

- Futures of some programs look strong because of mandatory professional registration (e.g., wastewater, potable water). Professional registration in those fields which do not require it (e.g., engineering and certain areas of radiation technology) are strongly encouraged because of the increased bargaining power in political contexts, as well as in securing employment.

- There is typically much interaction between the community and students, often through workshops, with a high degree of environmental commitment on the part of a small nucleus of dedicated people.

- The Environmental Protection Agency needs to develop training materials which are more structured in nature and approach.

- Most environmental topic areas enjoy positive images on campus with the exception of many programs in nuclear energy and radiation. These programs are often met with extreme negativity. While the situation is felt to be largely due to widespread misunderstanding, it is improving slightly with time.